

For power — and reliability — you will find that the air-oil cooled layout's limits are much lower than they are if the engine is soothed by water.

On the other hand...

Air-oil cooling has a number of plusses to argue for it, too: The layout is inherently simpler. There are fewer parts — you eliminate an entire system from the bike. No radiator, no hoses, no water pump. That means less in the way of regular maintenance chores, as well as fewer things to potentially break down the road and cost you money. It also means — usually — that the engine will be much more accessible and easier to work on. As well as prettier — because the engine will be cleaner — less obstructed from view by all the aforesaid stuff.

That's worth something, surely.

A few years ago, I was out riding my '03 Kaw ZRX1200 — a modern sport bike with a water-cooled engine. The temp gauge began to edge up to the unhappy zone and as I rolled up to a red light and stopped, I caught the can't-mistake-it-for-anything-else aroma of anti-freeze burning into steam. My bike's radiator had a pinhole leak — probably caused by a piece of road debris chucked into it at high speed as I was blasting down the highway a few minutes prior — and a jet of coolant was spritzing the headers. Luckily, I was not far from my usual bike store, so I gimped the Rex there — just barely making it before the needle went all the way red as the last of the coolant bled out.

The new radiator cost me \$400 — not including labor to install (I was sans tools and at their mercy).

Even if that never happened, it would still be necessary to periodically drain/refill the system with fresh coolant. Check — and, eventually — replace the hoses, thermostat and water pump. It's part of the deal. And water-cooled machines are prone to scale build-up and rotting of threads exposed to the coolant. A 40-year-old air-oil cooled bike has no such issues — but you have to be really careful about buying older water-cooled bikes. If the radiator of a 40-year-old bike is crusted up with scale, bet your bippie the inside of the engine is, too.

You'll never have that problem with an air-oil cooled bike like my '76 Kz900 (or my single cylinder dual-sport).

In fact, if you leave the thing alone — no high CR pistons, overbores and other such — and simply change the oil and filter every now and then — you'll probably never have any problems, period.

A water-cooled sport bike might get you there quicker — but an air-oil cooled one will always get you there.

And that's all I have to say about that.

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minutes before getting on and riding away?



It's obnoxious at a cafe when you're trying to sip your latte amid their fumes, but it's also fairly pointless and a waste of fuel.

It may also be doing their engine harm if they don't warm it up correctly.

Old motorcycles with carburetors and gluggy oils required a long period of warming up but surely today's fuel-injected engines with modern synthetic oils can go straight after you push the button, right?

Yes, but it also depends on how old the engine is.

If it's a new bike, it will require a few seconds - not minutes - to warm up. This is not only so the oils warm, but so the gaskets and valve

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Have you ever seen, heard and smelt a rider revving their motorcycle engine or idling their bike for

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carburetors to allow smooth starting from cold. And modern synthetic oils get the oil flowing quickly to lubricate the engine, even in cold conditions.

In fact, oil pressure rises when the bike is under load, so it is actually lubricating the engine better to be moving than sitting still.

If you idle modern bikes too long, or rev them hard before riding away, you can do long-term wear and damage to bearings and seals.



As for old bikes like my 1980 Honda CX500, let them idle with gentle revs not exceeding a third of the revs to redline. Allow the choke to slowly go back in

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seat properly in the new engine.

After the first 1000km, you won't need to warm it up for near as long, if at all.

RACQ technical guru and Suzuki Bandit rider Steve Spalding advises riders not to idle their engines any longer than is necessary.

"At traffic lights, it's unavoidable but there is no need to run at idle before starting off," he says.

"The best advice is to start the bike and ride away as soon as it will do so without any spluttering – in Queensland's climate this should be almost instantly almost all year round."

Modern engine management systems will ensure the fuel mixture is correct unlike the days of setting the choke on the

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with a gentle prod,
however you can
head off before the
choke is fully off.

Just make sure the
engine is running
smoothly at idle and
not conking out.

Don't just rely on the
engine temperature
gauge or feeling the
fins of the engine.

Once underway,
don't leave the choke
out for too long as
this can carbon up
internal components
such as valves, piston
crown and rings and
it makes the bike
blow black smoke.

The time it will take
to get an old engine
running smoothly will
depend on its
condition,
displacement and
configuration as well
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temperature.

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2 COMMENTS

Fagan

My 2010 Can Am Spyder RSS (Rotax VTwin) has over 110,000km on the clock and most mornings it fire and run, I have a few corners before I can consider opening the throttle, same applies if I decide to take my 2010 Triumph Speedmaster (146000km) and at 4:30am you want to keep the neighbours on your side!

18TH MARCH, 2015 AT 7:57 PM

REPLY

Johnny Boyle

The manual for my 07 BMW advised not to idle at all & says to be aware that the engine requires air cooling which may be an issue if the engine is running while the bike is at a standstill

18TH MARCH, 2015 AT 6:55 PM

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Why things are the way they are: A farewell to air-cooled engines - Common Tread - RevZilla

lugging a fully loaded touring machine through small-pace traffic in August versus the engine that's hailing around a small rider on a chilly fall afternoon at a leisurely pace. Air-cooled engines typically dissipate their heat through fins seen on the cylinders, and often the head itself.

A liquid-cooled engine has a narrower window of operating temperatures. Once warmed up, it typically runs at a pretty constant temperature. The water pump keeps circulating the coolant into the radiator and back to the engine, and if the bike's speed slows to the point where cool air is not flowing through the radiator to lower the temperature of the coolant inside it, a thermostat typically turns on an electric fan to draw the air over the radiator.

OK, so why do we need the radiator and the other junk?

Air cooling works well, but it has some shortcomings in terms of environmental impact. Because of the relatively wide range of temperatures considered "normal" for an air-cooled engine, clearances and fit tolerances between parts need to be pretty loose in order to allow for the expansion and contraction of parts. All those spaces can allow oil to seep into the combustion chamber. Burning oil is not so great for the planet.

Because air cooling an engine leaves a bit to be desired in terms of efficiency, intrepid riders and tuners often nicken the fuel-air mixture (more fuel, less air) on their bikes, because richer engines run cooler. Again, the problem with this method of cooling is that excess hydrocarbons are released into the air. It's not good for Mama Nature.

Liquid-cooled engines are typically a bit more forgiving when run lean, simply because the hot engine has more to heat up (the surrounding coolant) before causing damage. As manufacturers face more and more stringent emissions regs, they often simply run the engines lean to help meet the requirements. It's a good strategy — if the engine itself can put up with the heat. This is why many folks regret their carburetors or throw a fuel management unit on a fuel-injected bike as soon as they get it. The customers knew that the OEMs were not optimizing for horsepower, but rather, they made compromises to meet regs and move bikes out the door legally.



Traditionalists demand that the Harley-Davidson V-twin be air-cooled, but emissions and noise restrictions make it more difficult as time passes. Harley-Davidson photo.

Also, a happy side effect

Well, the final piece of the puzzle, believe it or not, is noise. Legislation is always cropping up to encourage quiet motorcycles. While exhaust noise is what everyone thinks about, it's the overall level that matters. If just so happens that a liquid-cooled engine is a bit quieter than its air-cooled counterpart. Why, you ask? That jacket of water that surrounds the engine deadens mechanical noise. If the engine is quieter, the manufacturer may be able, for example, to use a freer-flowing exhaust, and that can provide more power.

So, what does all this mean?

That most engines will be liquid-cooled going forward! While air-cooled engines will still be around, often for styling reasons, most manufacturers will produce primarily liquid-cooled engines for the U.S. market, because it is easier to meet emissions and noise regulations and increase power output. Much like retarders, air-cooled engines are probably as good as they'll ever get, because manufacturers will stop improving the technology. And that's just the way things are.

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Along with the Harley-Davidson V-twin, the BMW boxer is the most iconic air-cooled engine of recent times. But even these two classic designs have been given a little liquid help in cooling the heads these days. BMW photo.

Sep 11, 2014

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Why things are the way they are: A farewell to air-cooled engines



I'm an anomaly: a Harleyphile who appreciates liquid cooling, despite the fact that I currently own... uh, zero bikes that have given juice in them. Irrespective of what I own, I see the writing on the wall. Some Harleys now sport liquid-cooled heads, and the MotoCo's close work with Porsche on the scrapped Nova and successful Revolution projects was not a happy accident. Porsche is a company with a legion of rabid fans who successfully made the transition from air cooling to liquid cooling. Harley-Davidson notwithstanding, the obvious question is why liquid cooling has become the dominant method of keeping bikes at a correct operating temperature.

Nearly all new motorcycle designs are cooled by circulating liquid. Sure, you'll see some new bikes that are air-cooled, like the Suzuki Boulevard, but the Honda Rebel. Those are hold-over designs that debuted in the 1980s. Heck, even the new Yamaha SR400 is old hat! That tooling was bought and paid for a long time ago, so it makes sense for the manufacturers to get as many fruitful years from it as they can. However, any fresh designs you will likely going to be liquid-cooled in design. Let's explore why.



The Japanese manufacturers only sell a few air-cooled motorcycles in the U.S. market, and those are retro-styled bikes, such as this Yamaha SR400, older, carry-over models, or small, inexpensive, off-road bikes. Yamaha photo.

The difference between 'em

Air-cooled engines operate at a wider range of temperatures that are considered "normal." There's a big difference in the temperatures of an engine <http://www.revzilla.com/common-tread/why-things-are-the-way-they-are-a-farewell-to-air-cooling>



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Kevin Williams
I can stand up on my heritage, what's so difficult about that

Siperz

Very true! My favorite recent cruiser was the now-defunct (sadly) Victory Judge, but it was air cooled. The Scout looks great!

Geert Sturm

I have only ridden air and air/oil cooled engines, oldtimers, now I ride a Suzuki GS500E, twin, air cooled. Its not using oil at all, quite normal, when oil starts to sip in, in my opinion, thats when the engine has suffered from extremes, if u ride normal, with patience, to warm up the engine, things must work out fine, without extreme wear & tear.
still, liquid cooling has benefits when it comes to steady temperature, noise reduction, but... what about the air/oil-cooled engines vs liquid cooling... I would love to read an article about that :)

Michael

Great article! As I venture into the world of Harley Davidson with my first H-C product, ('98 Sportster XLH1200S) I have been interested in their after market liquid cooling product. It seems to me that would be a the first add-on I should be looking at above everything else.

David Corona

Thanks for the article Lemmy, looking to upgrade from my quarter liter mount in the very near future and my two choices include an air cooled L-twin or a liquid cooled parallel-twin. I'm drawn to the air-cooled L-twin because I feel that I would be easier to work on. Any thoughts on maintenance difficulty?

Lemmy

No sweat. You mention an air-cooled L-twin, which makes me think "Ducati". The liquid cooled P-twin is harder to pin down, but my guess there is Triumph/Honda/Kawasaki.

"Easier to work on" is a broad category. The engine itself? Probably the air-cooled beast... most of the time. Except for Ducatis, which use timing belts and desmo-metric valves. Metric bikes are fairly simply laid out. If you ask me.

If you're looking at something reasonably new, too, recognize that modern bikes are pretty damn reliable - even the unreliable ones. This is not 1985 - bikes are pretty long-lasting. I have plenty of chops that require LOTS of attention, but my daily commuter is always a liquid-cooled metric that I hog mercilessly, and I just pile the miles up on them.

I think your usage should dictate your choice, too - traffic and city work require liquid cooling in my book. Out in the sticks for a Sunday ride? Either will do.

David Corona

Well good sir, now that I have your attention, I'd like to draw on your expertise if I may be so bold. Yes, I'm extremely interested in a Ducati Scrambler, but concerned about expensive maintenance cost down the road. My other option is Kawasaki's Vulcan S, which has that bullet-proof 650, but doesn't get my blood going like the Duc. I only ride for pleasure so I don't believe overheating while in traffic is an issue. I'm more concerned about spending a grand or checking and adjusting valves on the red bike everytime there I cross that 15k mark. ☺

Pam Hunt

Regardless of US, the companies make good money on the coolant sold on a liquid cooled engine, more maintenance at the service stations.

Samer Zaidan

Thanks for all the great articles, Lemmy. I currently own a liquid cooled Honda VTX cruiser and I'm looking to upgrade, however I'm still confused on the matter. HD says air cooled with integrated oil cooler, others say air/oil cooling such as Honda CB, some BMW boxer engines, the Indian Thunderstroke 111 and Victory's Freedom 106. I'm not an expert on the matter but some of the more mentioned engines run oil through the heads with slightly bigger oil coolers to a great degree of cooling efficiency. Is this a better way of cooling than the HD method? (I know very little about HD) or is the exact same and the use of oil cooling as a marketing scheme? or are they not considered by purists as air cooled? I would greatly appreciate explaining the difference or whether there is any.

Lemmy

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Heath Collins

Well done Lemmy. I'm pretty surprised you didn't mention the new Indian Scout in this article. It shows many may/never that you can, in fact, produce a great looking liquid-cooled cruiser.

Lemmy

I write too much because I'm a blowhard, so I was trying to make Fearless Editor Lance's job a bit easier. His "Control" and "X" buttons are about worn out by now from me. I personally am OK with the way the Scout looks, and horsepower in the triple digits covers a lot of sins for me that its looks might have offended me with!

Heath Collins

My biggest gripe with cruisers is not their air-cooled engines though. My gripe is that not nearly enough of them come with mid-controls. One of my criteria for evaluating motorcycles is: "If I can't stand up on it, it's a no-go."

Lemmy

You might want to take a spin on a Dyna, or an odd 4-speed FX. I can pop up on my Low Rider like a big, fat, jack-in-the-box.

Heath Collins

Thanks, but no thanks. My current bike, a Z1000, makes my plenty happy. I've ever get a second bike (it'll be a sub-500cc supermoto, KTM 450 SMR maybe? A power cruiser would be an interesting third bike though. Maybe something ridiculous like a Suzuki M109R. lol.

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Ready G.

And another bit of knowledge about air cooled.. Harley has 57% of the marketplace here in the US and I don't think that is going away that fast yet. Air cooled will be here for a little while longer just because of the hard core following of the HD bikes. I will have to see what comes down the pike before I believe the air cooled will just die out in a few years yet...

Samer Zaidan

I agree but with that being said I've ridden a couple of mid 90's scottis and my VTX definitely roasts my legs a little less. But who cares we don't ride motorcycles because they're comfortable.

Lemmy

Yes, you'll see air-cooled bikes nearly everywhere you go - that's a given. However, I recommended a liquid cooled beast for those who ride in traffic not for comfort, but because air-cooled bikes need air blowing over them to cool correctly. Liquid-cooled bikes almost all have a fan, so when the coolant gets too hot, the fan kicks on and keeps the bike at the correct temp. (That is the thought, anyway.. theory and practice do not always go hand-in-hand) Occasional traffic shouldn't immediately herald the death of an air-cooled bike, but a steady diet of it is hard on the engine. Riders can pull off the road and wait for the bike to cool down (or traffic to clear). Alternatively, you can keep turning the bike off, but that makes the poor starter and battery tied in short order.

Samer Zaidan

I appreciate the insight. I love the hub BMW. I'm looking forward to more motorcycle reviews.

Lemmy

We're Common Tread now, baby! The Hub is deader than disco. I'm super-glad to hear you like reading, all the people involved with this have a real love of the game. Sean is currently our most prolific bike tester, definitely keep your eye on his articles for upcoming reviews.

Heath Collins

Disco is not dead. It just became techno.

Anthony

I will be a new rider by the end of this month. I've never rode a bike before. I will have the riding class next week, to learn to ride and get my NY license.. I've been looking at used bikes for sale for about a month. I'm interested in a cruiser type so I can join my friends who ride long distances.. There are two bikes that I'm interested in.. 2012 Yamaha 950 Vstar, that has 3200 miles on it, and is air cooled.. Other is a 2006 Kawasaki Meanstreak 1600, that has 3600 miles on it, and it is liquid cooled.. Both are in excellent condition.. And both are selling for \$5,200.00... I really like the meanstreak, but it is 9 years old. The other is 3 years old. I'm a lil weary about the air cooled engine.. Any advice from the experienced riders in this forum?

Lemmy

Do you ride in traffic?

REVZILLA

Senza Smart Helmet incorporates noise-cancelling technology

Avatar — But I like fumbling with ear plugs. Especially the part when they fall on the pavement and I have to fish them out from underneath my motorcycle and clean off the little rocks.

New Triumph Release Date Foiled by Meddling Dealers With Instagram

Avatar — One thing is for sure, competition is heating up in the 1200 cc twin range. I'm looking forward to a Scout, Sportster, Bonneville

Shreddin'

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Well, which Harley model are you talking about specifically? HTU is primarily air-cooled only, with no oil cooler. There are some factory models that had oil coolers, and there are also models sporting heads cooled by liquid as well, and to confuse the issue even further, the VROD and Streets are fully liquid cooled.

I am not giving opinions out in this article, but it is factually safe to say that with the exception of full liquid cooling, most of HD's methods could keep the engine at a more consistent temperature. Air cooling is the least efficient way to cool an engine, followed by air-and-oil, followed finally by liquid cooling.

An item of note is that strictly in terms of longevity, cooling the engine does not necessarily make it last longer. That is generally true, but an engine built sufficiently stout can be made to live a long and happy life.

Were I you, and I were dumping my VTX for something else, I would get what I liked - who cares what the purists think? They're don't make the bike payment!

Lampshade

With Project Rushmore, H-D is making the slow transition towards having the entire line water cooled (at least partially). Some of the Rushmore motors are still only air cooled, but many are "twin cooled". I've heard that they will make the change across the board within the next couple of years.

Lemmy

Perhaps, but it would seem that a wholesale rebuilding a la Porsche would be the brighter way to accomplish that. It seems almost necessary - right now the only way they can slash all the "stuff" is to use the lowers. It would be certainly hard to stuff a set of lowers on a Dyna or a Softy and make it look natural. I look forward to it, though. Sure I am a lover of tradition, but I love going fast, too. If HD can break the air-cooled mold, hell, they can start making some really wild stuff. Their R&D team certainly would cook up some interesting designs. I would imagine.

Samer Zaidan

I agree I don't care what the purists think and I'm not brand loyal either. I was just curious about how things worked and why things are the way they are but more importantly what works best for me. I'm looking for a minimalist cruiser or bagger, something slim, street glide special (which is the one with integrated oil cooler), I appreciate the explanation.

Lemmy

Well, I think any system will be transparent to the user most of the time. If you are riding in traffic a lot, a liquid-cooled bike is probably the way to go. Other than that, I think you'll do well with any modern bike in terms of it cooling adequately.

Samer Zaidan

I see plenty of air cooled bikes here. I live in north Florida. Summers are brutally hot either way. I've been on a friends Honda 919 and it was just as hot as my VTX sitting in traffic.

Unfrustrator

For what it's worth, the radiator's job isn't to keep you cool. It's to keep the bike cool. You might bike as you're dragging toes down the interstate at 30mph, but the bike should be good and dandy.

It still kind of surprises me that my Speed Triple can hold temperature sitting still for 20 minutes. The RC could never do that.

Ready G.

I went on the ride to Washington DC last year (2013) and we had 1.3 million riders show up for that rally, if you can call it that. But in the short of things, it was 80 degrees and no wind at all on 9/11 and we were not going anywhere fast in the DC traffic. About a block in 20-30 minutes. And even the water cooled bikes were having to pull over with their engines starting to ping. So even with radiators, the bikes were overheating. My Ultra Classic is an 07 and that was the first year that the gov. got down on HD for exhaust gases. Mine has a SERT (seemingly eagle race tuner) and has been placed on a dyno but that was because I rebuilt the engine from the 66 cc. up to the 103 by boring out the seasoned pigg. My bike reached 227 degrees after a couple of hours of not going anywhere and every time I would tap the throttle a little quick, I would get a loud ping from the motor. But like I said, even the water cooled bikes were pulling over at the Washington Monument park and cooling their bikes down also. Everyone was having a hard time cooling everything down. Bikes and ourselves also...

<http://www.revzilla.com/common-tread/why-things-are-the-way-they-are-a-farewell-to-air-cooling>

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Exhibit B

11/4/2015

Why things are the way they are: A farewell to air-cooled engines - Common Tread - RevZilla

<http://www.revzilla.com/common-tread/why-things-are-the-way-they-are-a-farewell-to-air-cooling>

Exhibit B



EXHIBIT
Vigilante 12
8/3/15/16
tabbles

Exhibit B

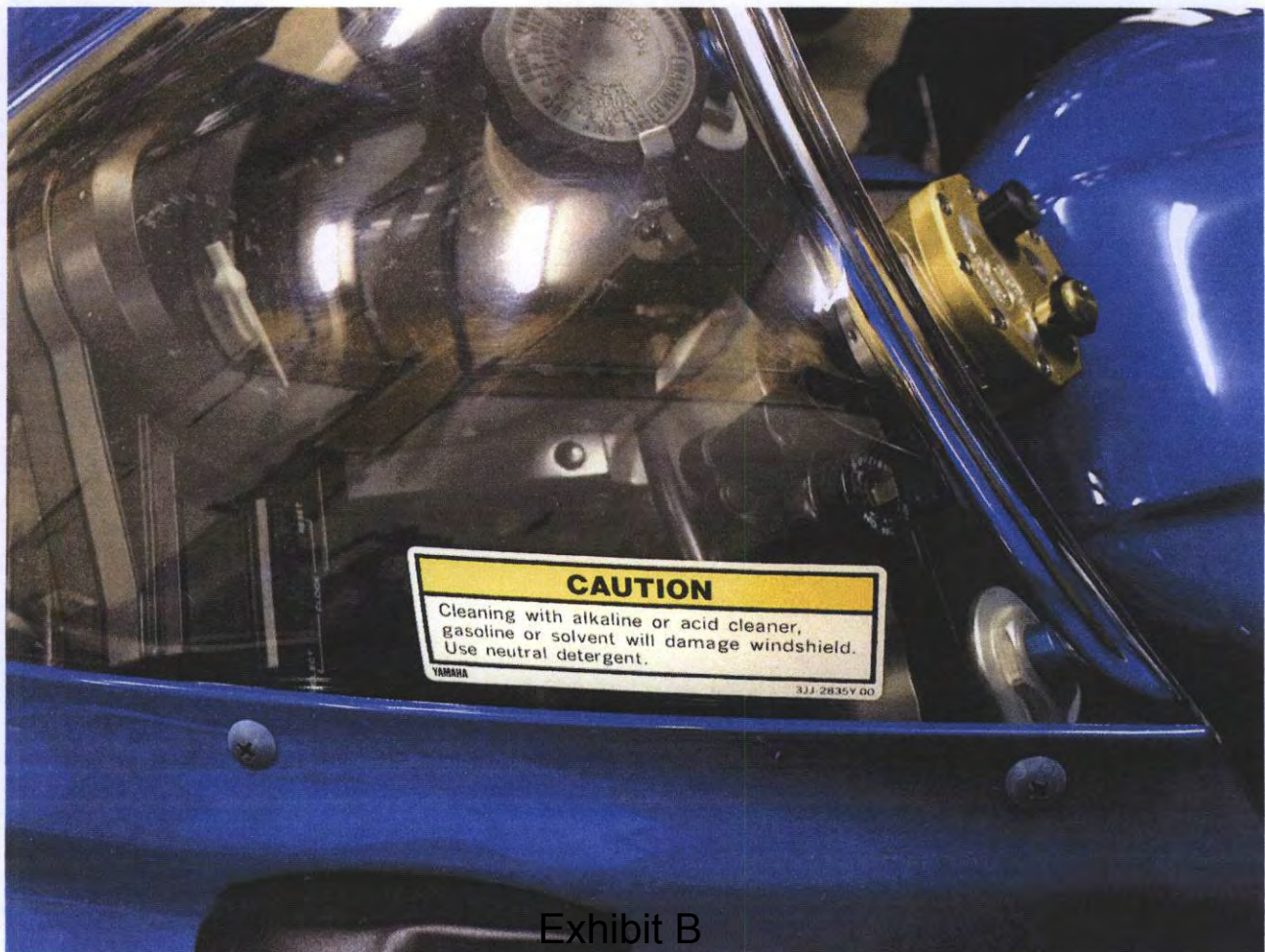
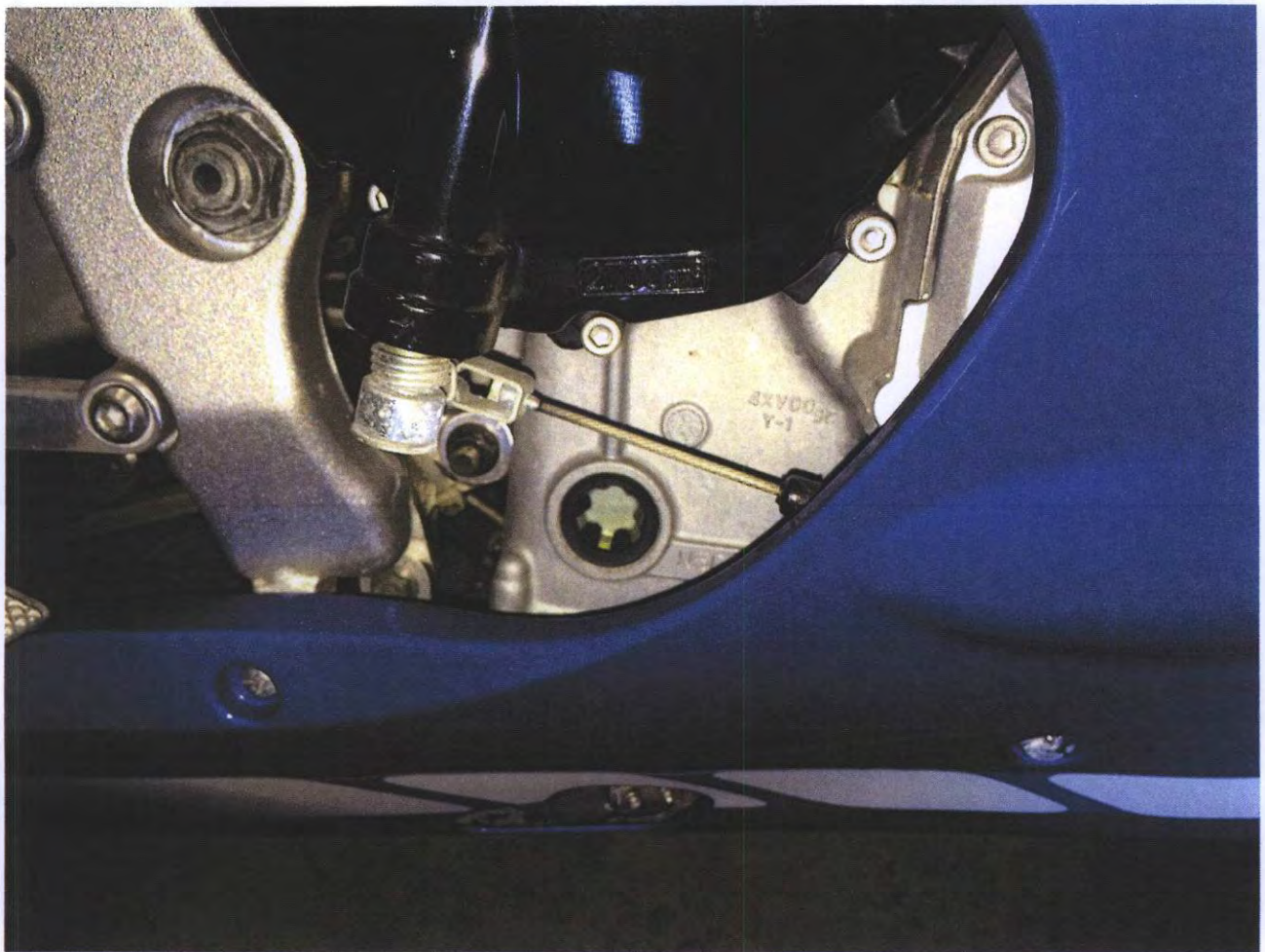


Exhibit B



1998
YZF-R1
1000 cc



Exhibit B

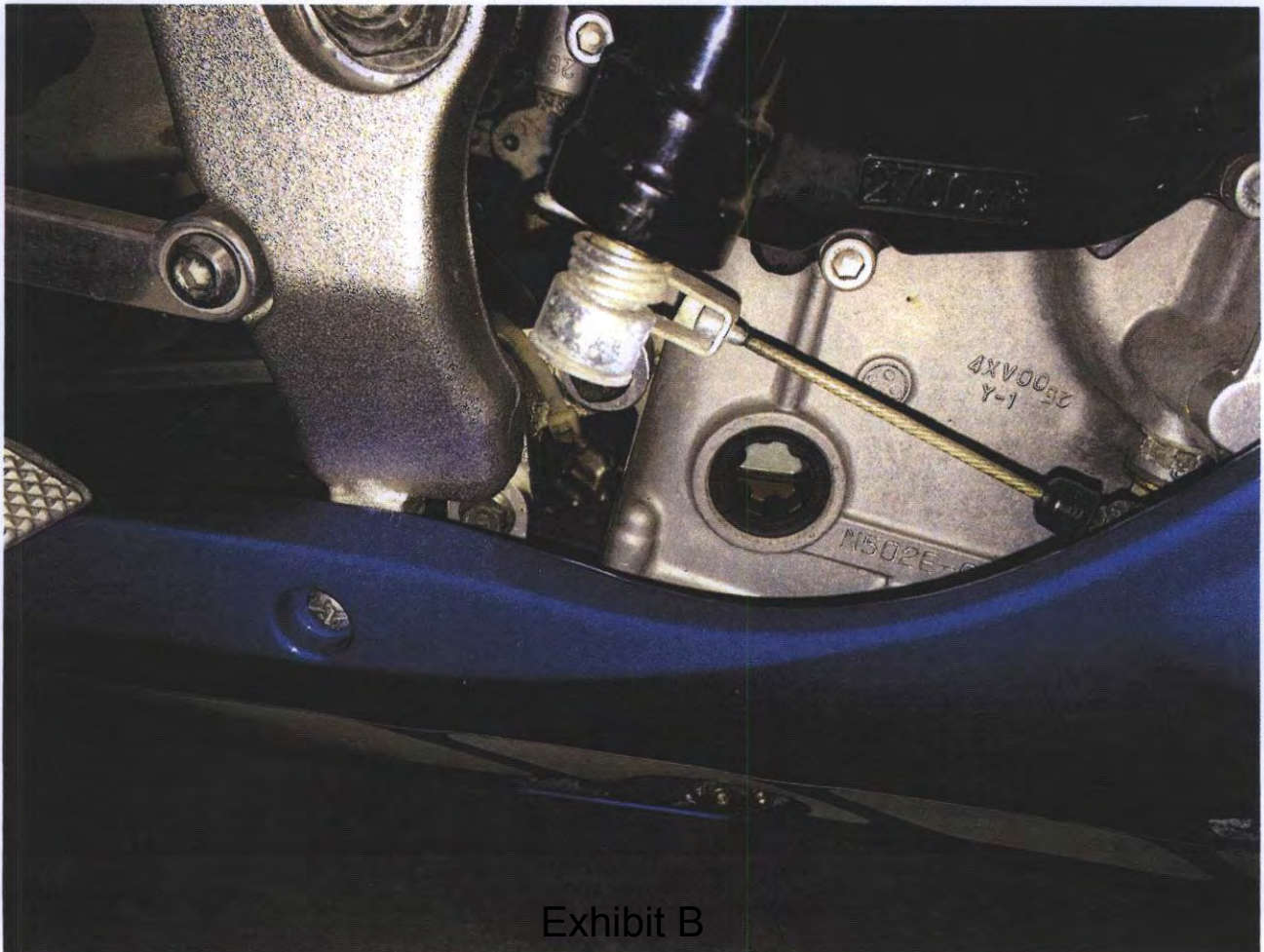


Exhibit B



EXHIBIT
tabbles
Vigilante-13
3/18/16

Exhibit B

2010



Exhibit B

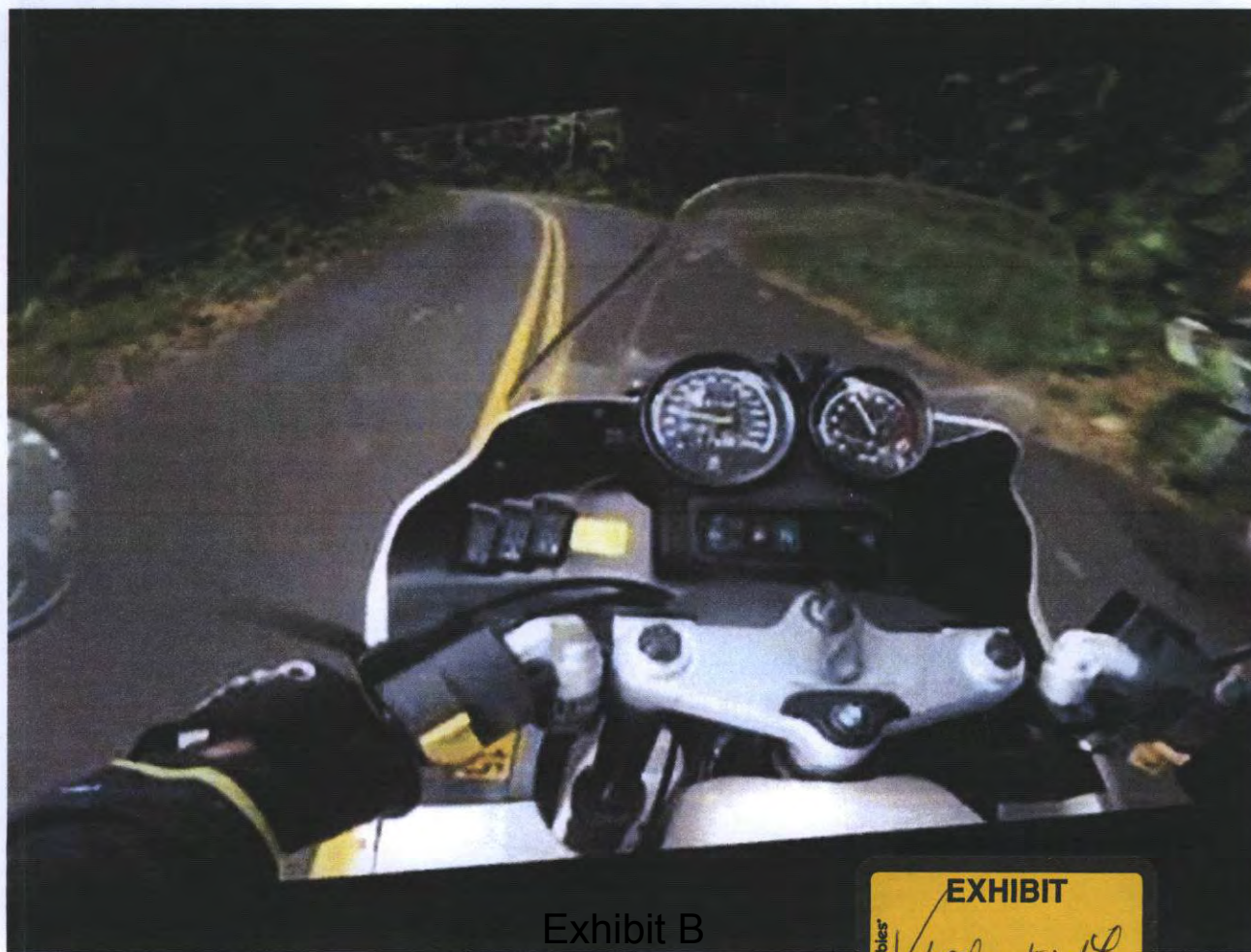
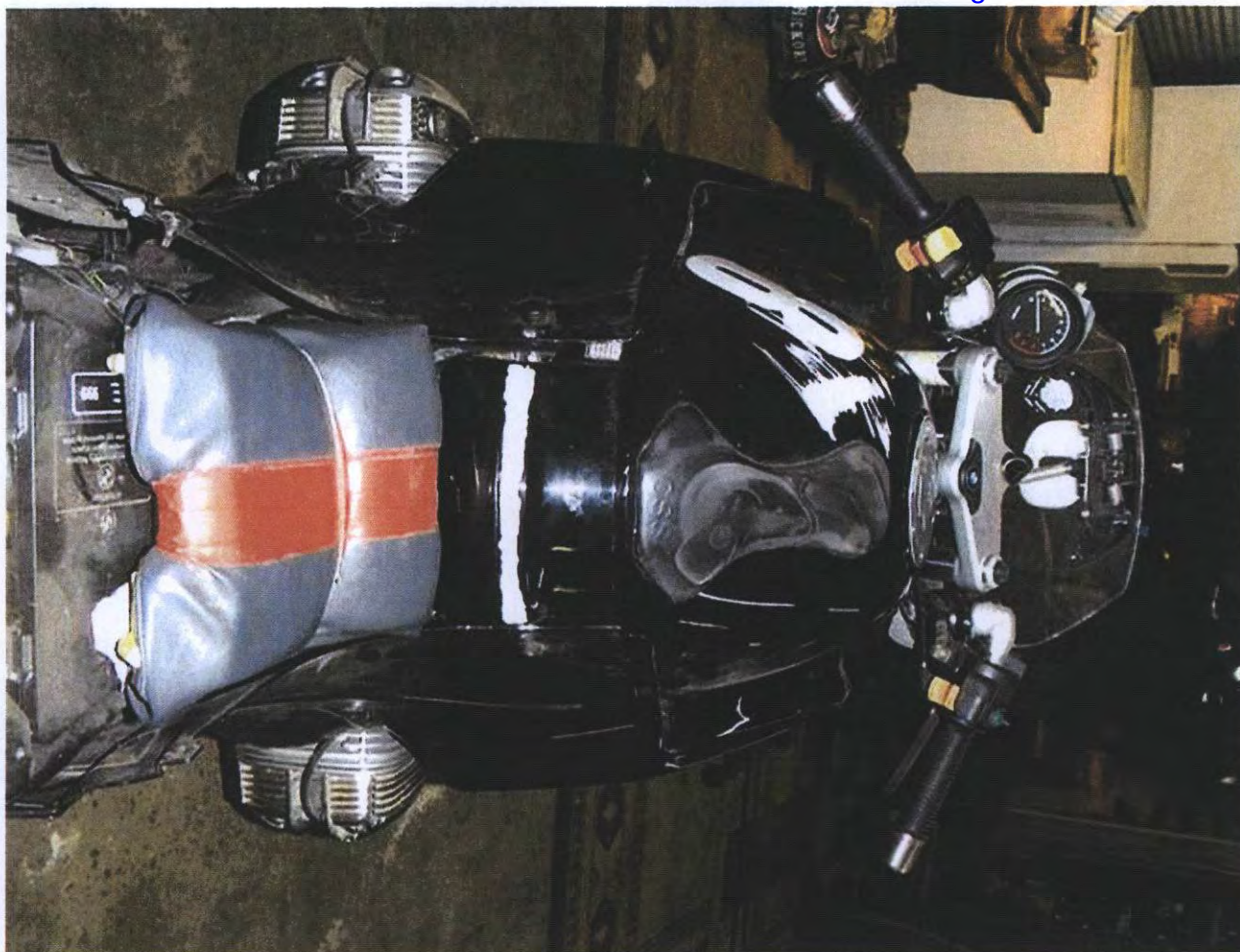


Exhibit B

R1100RSL

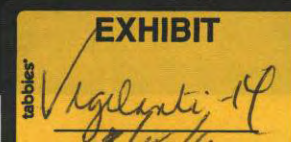




Exhibit B

CORRECTIONS:


William Vigilante Jr., Ph.D.

Deponent Signature Page

I do solemnly declare under penalty of perjury that the foregoing is my deposition under oath; that these are the questions asked of me and my answers thereto; that I have read same and have the necessary corrections, additions or changes to my answers that I deem necessary.

In witness thereof, I hereby subscribe my name this
____ 4th _____ day of _____ April _____, 2016



William Vigilante, Jr., Ph.D.